



NOAA

GLM Value Assessment Briefing (Version 1.1)

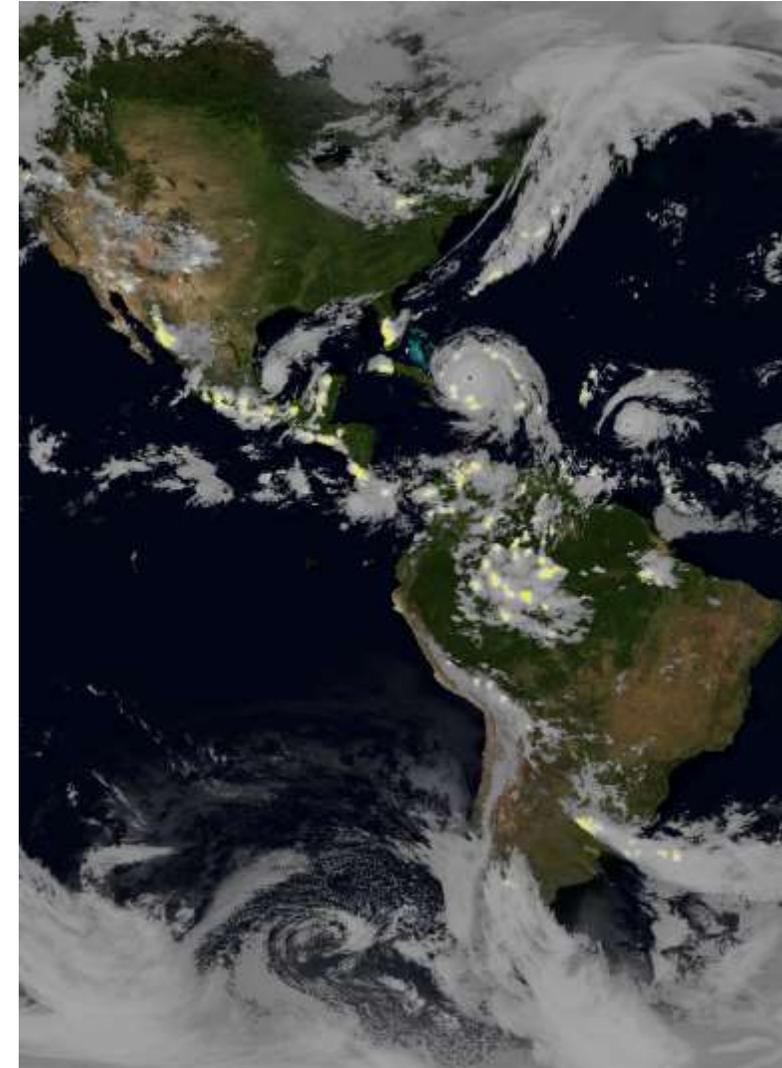
Scott Rudlosky, NESDIS/STAR
GLM Science Team Meeting
8 September 2020



GLM Value Assessment Overview



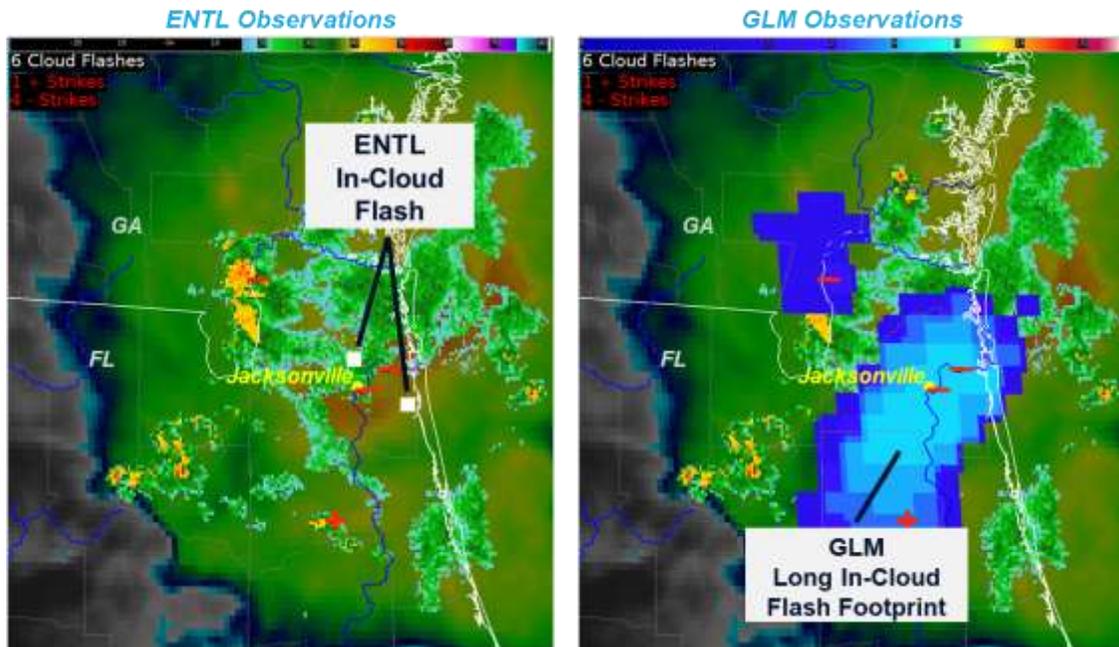
- **Geostationary Lightning Mapper (GLM) value assessment (VA) aims to advise future satellite architecture decisions**
- **Societal and forecast benefits are captured regardless of whether they can be quantified in dollars - quantitative assessments are provided where possible, but qualitative assessments are the focus**
- **This study evaluates GLM value by documenting benefits to the public via decisions made by end users**
- **Operational use cases help illustrate GLM value being realized through operational decisions by a wide variety of decision makers (i.e., both NWS and non-NWS).**



Improving Lightning Safety



- The GLM will provide huge socioeconomic benefit as access is gained by users who traditionally could not afford to purchase lightning data (e.g., boaters, emergency managers, large venue organizers, and local athletics officials), leading to fewer injuries and reduced loss of life.



GLM depicts the entire flash footprint, revealing a connection between these distant storm cores not readily apparent with the ENTL flash locations

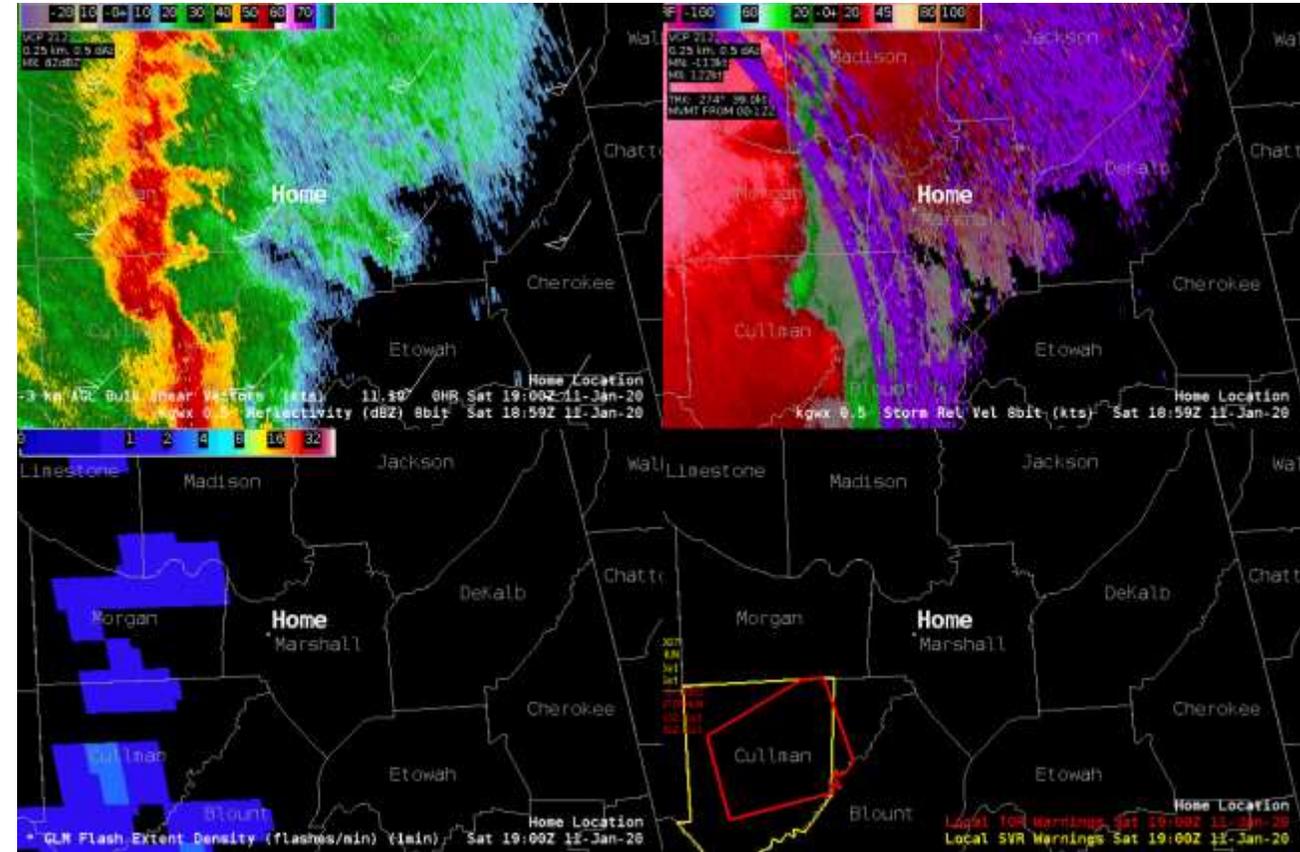


Video shows long lightning channel striking ground several km apart

Improving Severe Thunderstorm and Tornado Warnings



- GLM data integrated into the severe warning process promotes earlier and easier warning decisions, better assessment of the areal coverage of hazards, and reduction of unnecessary warning coverage and false alarms, especially during radar outages and in regions with poor radar coverage.



AGU EOS Article: Goss, H., 2020: Lightning Research Flashes Forward, Eos, 101, <https://doi.org/10.1029/2020EO142805>, Published on 24 April 2020.



Improving Severe Thunderstorm and Tornado Warnings



- Shared a compelling story from an AGU EOS Article: *“Lightning Research Flashes Forward”* by H. Goss
- Untimely radar outage prevented accurate judgments on storm rotation near the ground, but forecaster (Ravenscraft) was getting consistent data about one piece of the storm that would become key: lightning.
- “If we start to see these lightning jumps, and we see these updrafts grow, especially combined with the surge in the line we can see on radar, then there’s a good chance we’re going to end up with a tornado.”
- When the storm reached her coverage area, eight reported tornados touched down. Ravenscraft had successfully predicted and sent out a warning for each one.
- “From that event, we realized how significant the GLM data was.”
- “GLM was the decision maker,” Ravenscraft said. “If we had only had radar, we may not have decided to issue that warning.”



Improving Safety and Effectiveness of Wildfire Response



- The GLM benefits the firefighting community's awareness of the lightning threat through enhanced detection of lightning strikes most likely to ignite fires, better pyrocumulonimbus identification and characterization, and thorough forensic studies associating cause to potential lightning ignited fires.



CALIFORNIA STATEWIDE FIRE SUMMARY

THURSDAY, AUGUST 27, 2020



OVER 300
DOZERS

270
FIRE CREWS

OVER 15,600
FIREFIGHTERS/PERSONNEL

OVER 370
WATERTENDERS

OVER 2,400
FIRE ENGINES

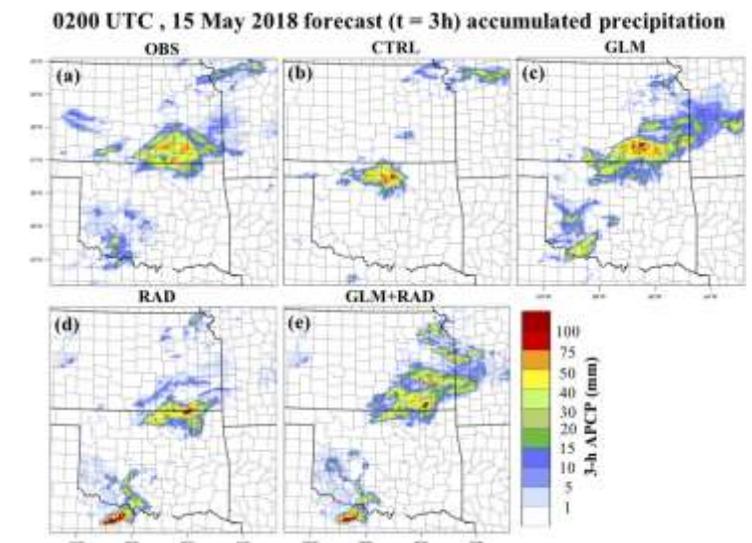
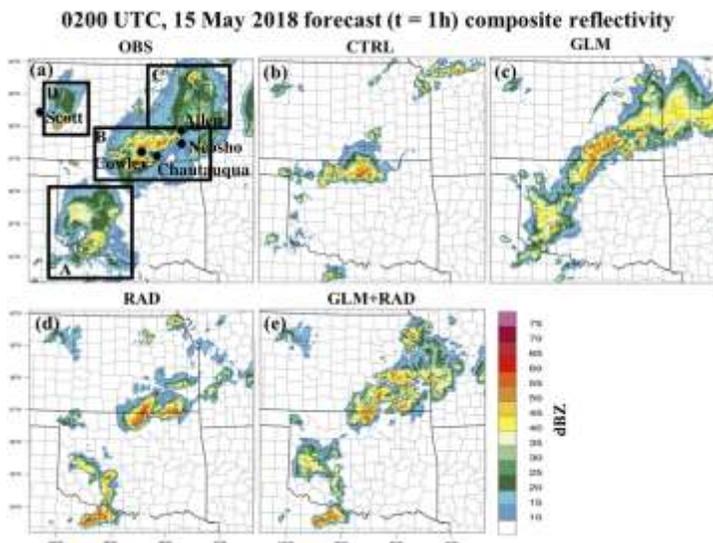
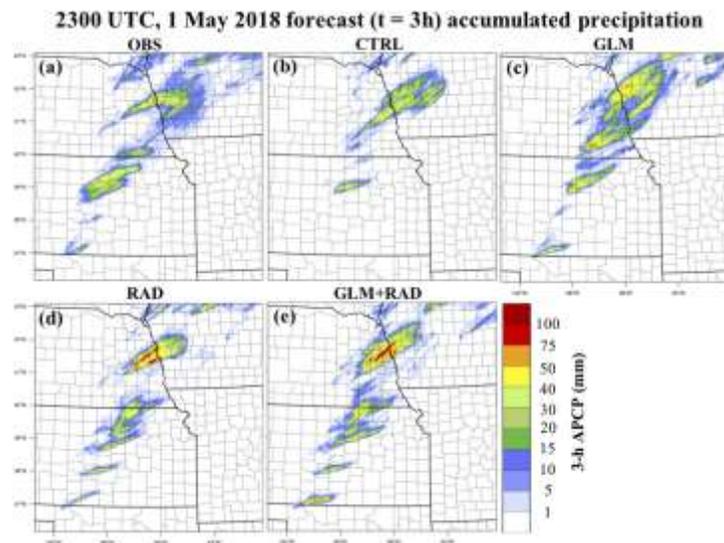
MORE THAN 15,600 FIREFIGHTERS TODAY ARE BATTLING OVER TWO DOZEN MAJOR FIRES AND LIGHTNING COMPLEXES ACROSS CALIFORNIA. IN THE PAST 24-HOURS THERE WERE OVER TWO DOZEN LIGHTNING STRIKES IN NORTHERN CALIFORNIA. SINCE THE LIGHTNING SIEGE THAT STARTED ON SATURDAY, AUGUST 15, 2020. THERE HAVE BEEN MORE THAN 700 NEW WILDFIRES, WHICH HAVE NOW BURNED OVER 1.35 MILLION ACRES.



Improving Short-term Model Forecasts (Data Assimilation)



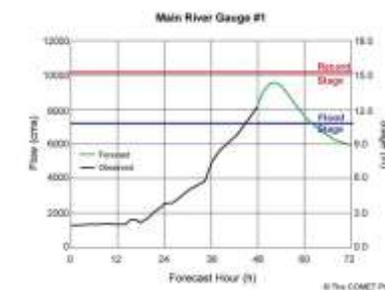
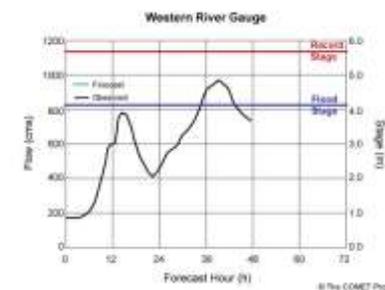
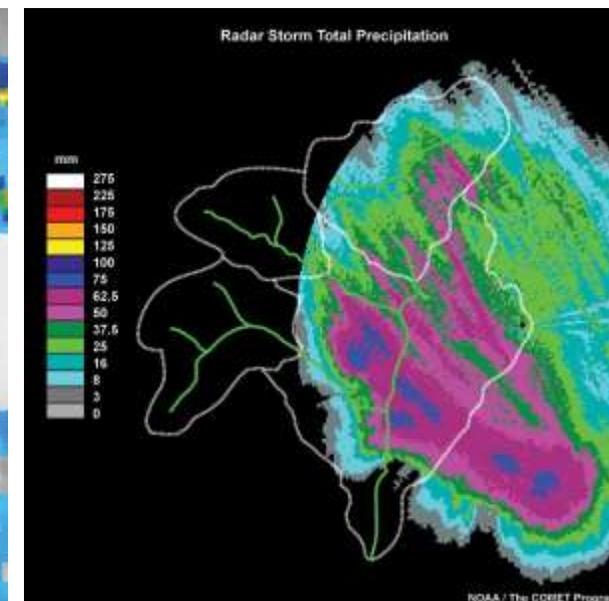
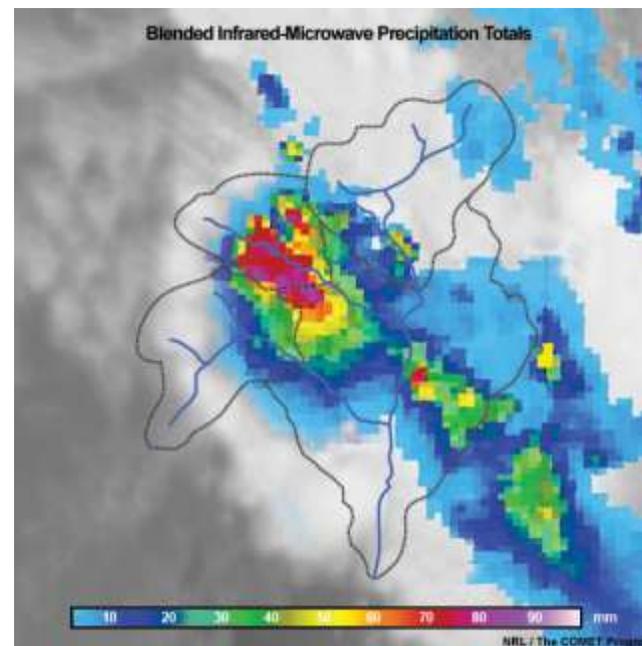
- Lightning data assimilation is a relatively young field, especially GLM data assimilation, but early results indicate many benefits, especially short-range forecasts of radar reflectivity, accumulated precipitation, and lightning threat in convection-allowing models.



Improving Precipitation Estimation



- GLM observations can improve satellite precipitation estimates which benefit flash flood forecasting in significant portions of the western US, Hawaii, and US territorial island possessions that do not have adequate radar coverage, reducing risk to life and property.



Example from COMET flood forecasting training

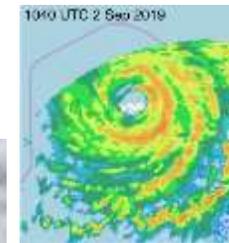
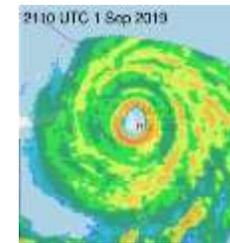
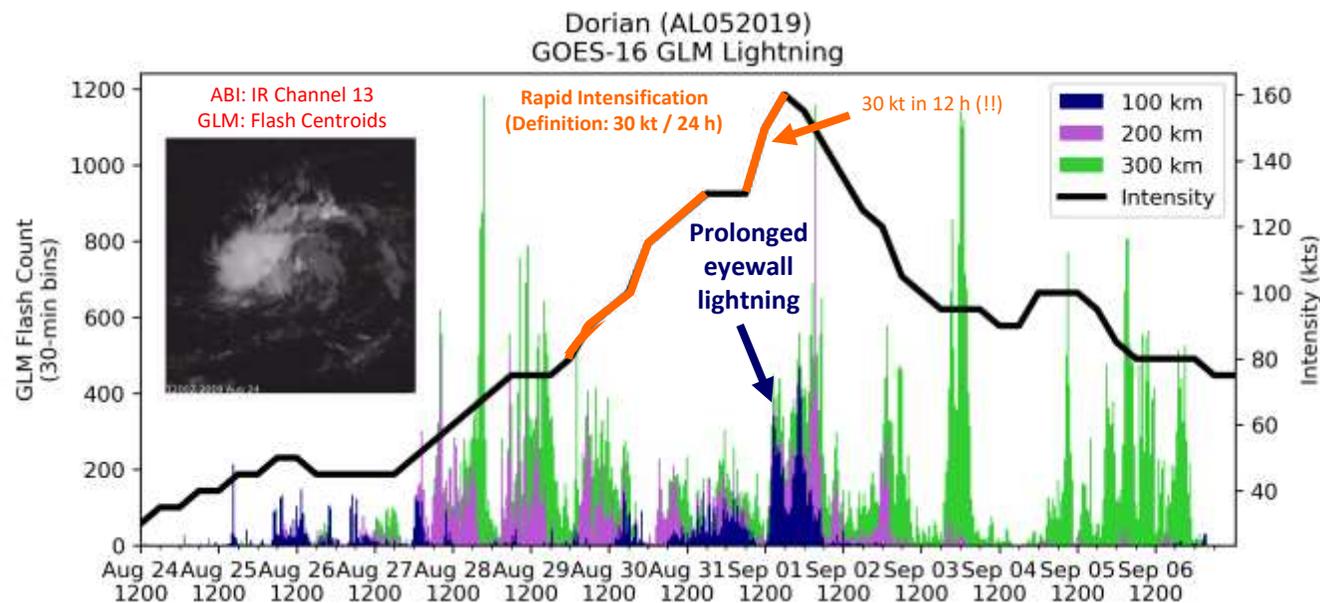
http://ftp.comet.ucar.edu/memory-stick/hydro/basic_int/case_study/index.htm



Improving Tropical Cyclone Diagnosis and Warning

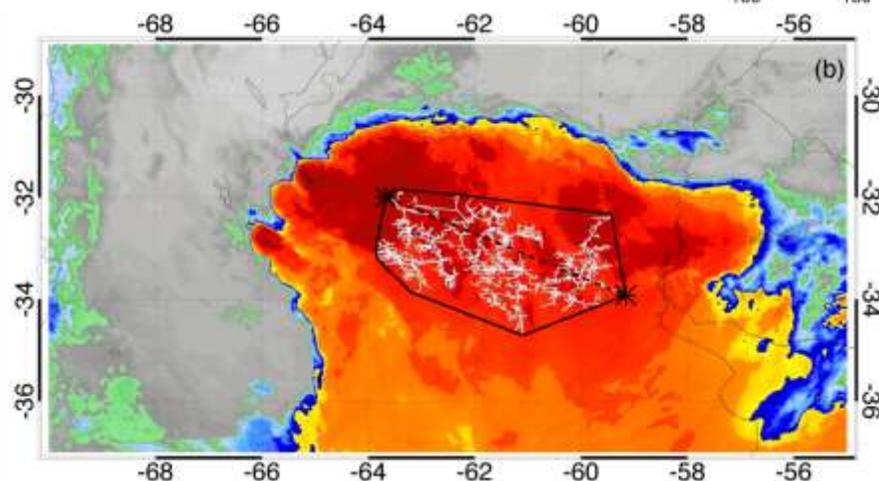
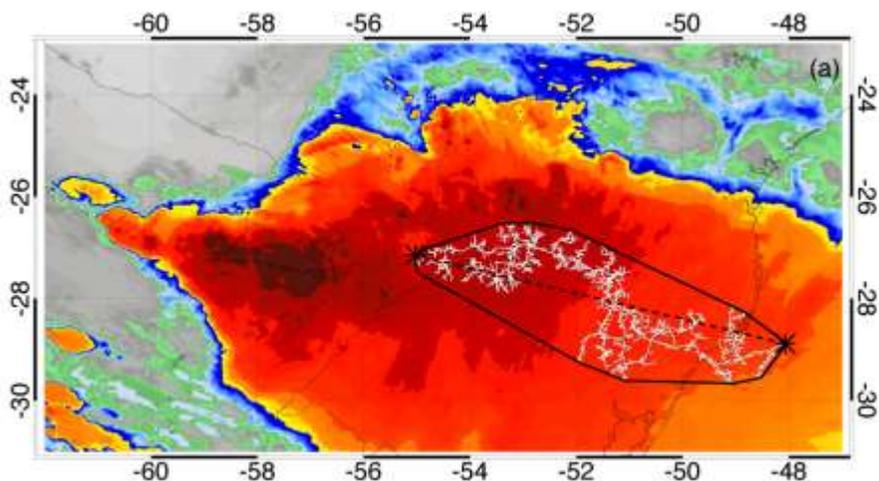
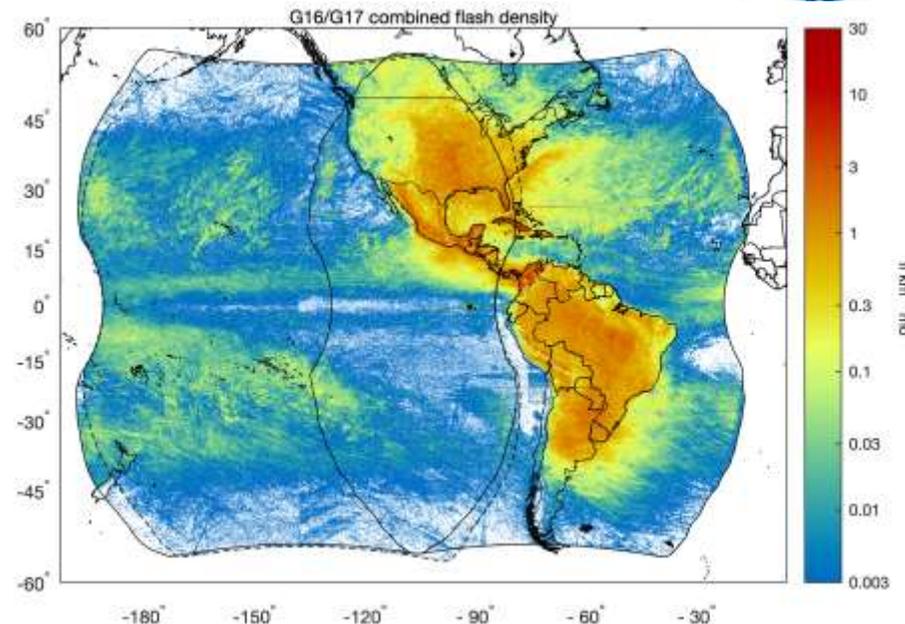


- GLM provides unique insight into the vigor and pattern of convection below the cloud tops in tropical cyclones (TCs) outside the range of land-based radars, this helps better diagnose TC structure and evolution and aids near-term forecasts of TC intensity change including rapid intensification.



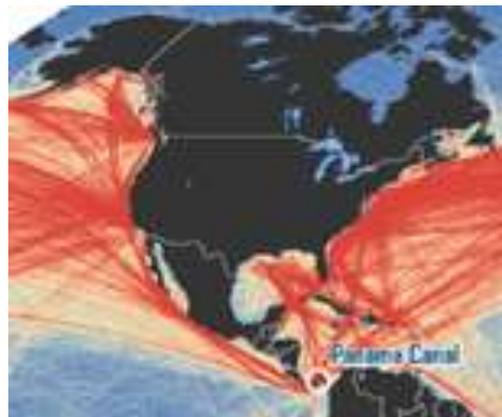
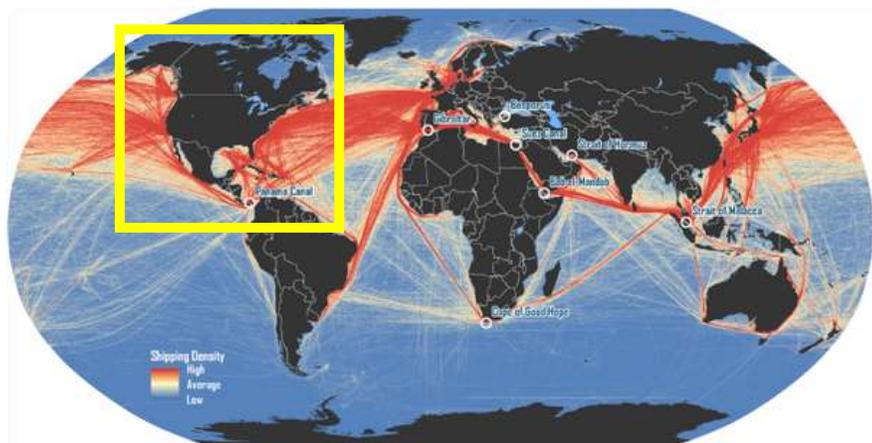
Improving Climate Applications

- As the GLM fulfills its mission to accumulate a long-term database to track decadal changes in lightning activity, initial value is being realized through improved diagnosis and characterization of the lightning threat by a variety of end users, including those most vulnerable to a newly defined class of world record breaking long lightning flashes.



Value of Filling Data Gaps

- The GLM's broad spatial coverage and rapid temporal updates complement radar observations over CONUS to better support forecaster warning decisions. Rapidly updating GLM observations over vast (often data sparse) regions provide decision makers with information they need to forecast, monitor, and react to thunderstorm hazards.



Above: WSR-88D Radar Coverage
Left: Shipping traffic density
Right: Weather-related radar damage



Value of Filling Data Gaps



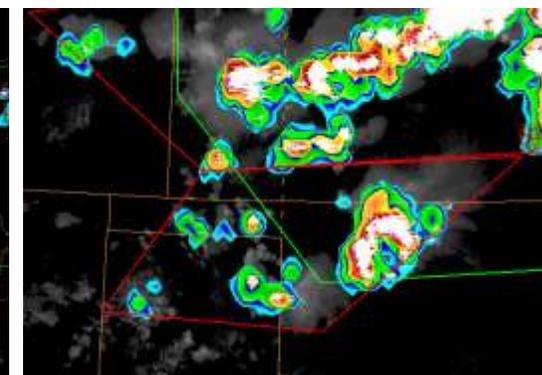
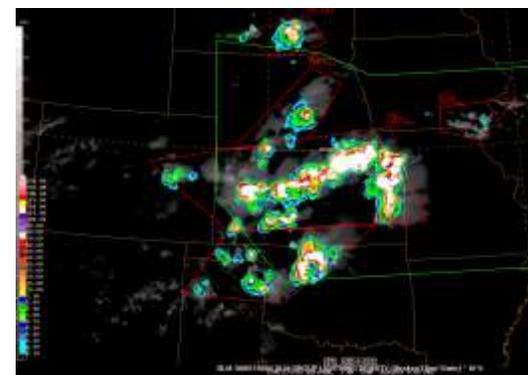
GLM Application	Estimated Annual Value (present)	Value with Full Capabilities	Value with Redesign
CONUS			
OCONUS			
Filling Data Gap Total			

- **Hold**

Value of Mitigating Aviation Hazards



- The GLM observes the complete spatial footprint of total lightning flashes (IC and CG), which helps better characterize the lightning risk and increase confidence/certainty when suspending ramp operations, leading to enhanced safety, improved efficiency, and cost savings. The GLMs broad coverage and rapid updates provide tremendous cost savings to the aviation industry through improved diagnosis and avoidance of thunderstorms, especially over oceans.



Value of Mitigating Aviation Hazards



GLM Application	Estimated Annual Value (present)	Value with Full Capabilities	Value with Redesign
Ramp Operations	\$7 million	\$10.5 million	\$15.5 million
In route	\$10 million	\$15 million	\$20 million
Aviation Hazards Total	\$17 million	\$25.5 million	\$35.5 million

- **Assuming the GLM has reduced unnecessary ramp closures by 5% results in an estimated annual value of \$3.5 million, improved tools and training could double this contribution.**
- **Better characterizing the lightning hazard and deploying tools to efficiently communicate the information, assuming only 20% of this societal benefit has been realized provides an estimated annual value of \$3.5 million.**
- **GLM benefits stemming from improved NWS/AWC forecast products and their impacts downstream (e.g., FAA TMUs, airline dispatch centers, general aviation) provide an estimated annual value of \$5 million through reduced fuel burn, delays, diversions, and inadvertent flights through storms.**
- **The present cost savings realized through better diagnosis and avoidance of thunderstorms offshore brought on by the GLMs broad coverage and rapid updates is estimated to be at least the same order of magnitude as the ROMIO demonstration (estimated annual value of \$5 million). Full integration of GLM capabilities could provide an additional \$5 million in potential value offshore.**

Summary



- **Less than 4 years since becoming reality, the GLM is well on its way to becoming a legacy instrument ubiquitous across a wide variety of meteorological applications.**
- **The GLM now provides a national baseline of freely available lightning data and establishes a baseline for widespread industry implementation.**
- **The GLM moves from traditional point sources of lightning information to a rapidly-updating 2-D map that accurately portrays the full spatial extent of lightning activity.**
- **Many operational users (e.g., NWS) have eagerly embraced this new source of lightning information and incorporated it into their workflow (e.g., Huntsville, AL).**
- **The GLM value will quickly multiply as the benefits realized in Huntsville spread.**
- **Despite widespread use of lightning datasets, the GLM remains in its infancy and much of its value still waiting to be fully realized.**